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TITLE: Telecommunications for Mars Rovers and Robotic Missions

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Telecommunications plays a key role in all rover and robotic missions to Mars both as a conduit for command information to the mission and for scientific data from the mission, Telecommunications to the Earth may be accomplished using direct-to-earth links via the Deep Space Network (DSN) or by relay links supported by other missions at Mars. Due to the power and mass constraints on systems at Mars that may prohibit direct-to-Earth telecommunications, most of the planned Mars orbiters will provide relay communication support for atmospheric or surface elements **such as balloons and rovers**. This paper reviews current plans for missions to Mars through the 2005 launch opportunity and their capabilities in support of rover and robotic telecommunications. (A companion paper, "Principles of Planetary Rover Telecommunications," describes direct-to-Earth communications.) The review will provide Mars rover and robotic designers with information concerning Mars telecommunications options and design considerations (e.g., antenna and power requirements) for use in their system design.

The distance between Mars and Earth, the inability of Earth-based systems to regularly communicate to all portions of Mars, and the substantial power and/or antenna requirements may prohibit direct-to-Earth communications for robotic or rover missions at Mars; especially small systems. By decreasing the communications range and providing coverage to nearly all portions of the Martian surface, orbiting missions with telecommunications relays can send and receive large amounts of data to and from rover missions and relay these data to and from Earth. These orbiting relay systems are viewed as enabling missions as they provide telecommunications support for multiple missions including extremely constrained missions such as micro rovers or balloons.

With the launch of Mars Pathfinder and Mars Global Surveyor (MGS), the next generation in Mars exploration has begun. Over the next decade, the Mars Exploration Program led by NASA and the Jet Propulsion Laboratory (JPL), intends to launch one or more missions during each of the launch opportunities in 1998, 2001, 2003, and 2005. The orbiting missions starting with MGS will each carry a UHF communications package that will provide a relay link to and from appropriately equipped missions. The paper will describe the relay capability of MGS, the 1998 Mars Surveyor orbiter, and the planned capability for future missions. This description will include both link design considerations and multi-mission support operations necessary for rover and robotic designers based on results from a JPL-led study of relay communications at Mars.